Extension Bulletin 212
May 1940

CLEARING LAND With the BULLDOZER

A. J. SCHWANTES
and
M. J. THOMPSON

• University of Minnesota •
AGRICULTURAL EXTENSION SERVICE
• U. S. Department of Agriculture •

Clearing Land with the Bulldozer

A. J. SCHWANTES AND M. J. THOMPSON

AT LEAST forty acres of improved land per farm is necessary to make the farm family self-supporting. But according to the 1935 census, the 33,840 farms in fourteen cutover counties in northeastern Minnesota average less than 36 cleared acres per farm. In some counties the average was as low as 16.5 acres per farm. About one-fourth million additional cleared acres are necessary to bring the improved acreage for each farm up to forty. Obviously a good deal of land clearing and improvement is needed to establish a sound social and economic program for this area.

Although until recently explosives have been the major agent used in stumping, lands have been cleared by other means as well. During the late "thirties" farmers discovered that the large size track-type tractors equipped with bulldozers set at an angle, which were making such good roads, could remove stumps cheaply and efficiently. In 1939 nearly a dozen such outfits were operating in northeastern Minnesota.

For best results these tractors should have a rating of about 40 horsepower on the drawbar. Larger tractors can be used advantageously. A blade attached at the front is variously known as bulldozer, bull grader, or angle dozer. This blade is designed especially for the tractor and is equipped with devices by which the operator can control the blade's vertical position from the tractor seat.

The individual farmer cannot afford to own an outfit for clearing his own land because of the large investment necessary. It appears most practical for one who can spend all of his time at the work to own the outfit and do custom work for other farmers. In this bulletin those who own and operate machines are termed operators.

SURVEY AND OBSERVATION

In order to evaluate this method and to determine both its relative advantages and possible limitations, the Division of Agricultural Engineering made a study of the work in 1939 among both farmers and operators. A questionnaire was mailed to farmers in several counties of the cutover area, and 60 of these were returned. Nine operators also responded to questionnaires and additional observations were made of a number of machines in operation under different conditions and of many fields where work had been done or was in progress. The findings of this study are reported here.

Getting cutover land ready for crops includes brushing, stump removal, stump piling and burning, breaking, and in some cases stone removal and

root picking. The tractor with a bulldozer is used primarily for stump removal. To complete the job of clearing, extra labor and materials are necessary because these operations are not performed by the bulldozer.

BRUSHING

The first clearing operation on most cutover lands is brushing. This may consist of the removal of either a rather heavy stand of second growth or a light stand and small brush. In any case, brushing should be completed before stumping is begun.

Sixty per cent of the farmers reporting in the survey stated that there was brush on the land cleared with the bulldozer. Over half, however, had cut the brush before the tractor arrived, whereas 15 had the tractor with bulldozer clear the brush as well as stumps. Practically half of those who had brushing done stated that it was not successful, but the other half stated that it was.

Most operators in brushing scrape the ground at, or slightly below, the surface thus cutting off the brush roots or pulling many of them out. At the same time much top soil and leaf mold is carried with the brush, all of which is then rolled together and piled into a windrow. Those who do not favor brushing with the bulldozer complain that too much dirt is included, and consequently burning is difficult. Observations confirm this objection.

It has been found, however, that second growth large enough to be removed by pushing over rather than scraping at or below the surface can, in many cases, be successfully removed. On several fields small trees were pushed over and piled in windrows about 25 or 30 feet apart. After remaining in the windrow for several months, the trees were burned successfully. Usually a stand of second growth four inches in diameter or over is merchantable, and the return will more than pay for the cost of cutting. Smaller growth, especially mixed sizes down to small brush, presents problems when removed with the bulldozer.

One operator successfully handled brush on a large scale while the ground was frozen. Here the bulldozer cuts and breaks off the brush near the ground surface. For stems one to two inches thick, the blade is set close to the

Ready for the Bulldozer

A stump field from which brush has been removed, and preferably pastured, permits the use of the bulldozer to good advantage.

Remove Stumps By Sections

Removing large stumps in sections makes piling easier, and less dirt is carried out.

frozen surface; for larger growth the blade is raised slightly, and the trees are pushed over. The roots are held firmly in the ground, thus facilitating breaking at the surface and practically no dirt is taken with the brush.

Brush During Slack Periods

Brushing can usually be done effectively during slack seasons by the farmer with the available help requiring no cash outlay. It is advisable to brush the land two or three years before stumping. By doing this the farmer will have a grass sod valuable as pasture on the land immediately after brushing. Pasturing will in turn discourage brush sprouts from growing and will facilitate the decay of the brush roots. This will put the land in condition for easier and more satisfactory stump removal and for raising better crops after stumping and breaking. To obtain these advantages, the farmer must push his brushing program now to provide land ready for stumping in the future.

STUMPING

Stump removal is the most costly and troublesome phase of land clearing. It usually cannot be done by farm labor without some assistance. While the use of explosives is most common, mechanical pullers, operated with either horses or mechanical power, have been used. Stump removal requires not only a cash outlay but also considerable labor as well. Moreover it usually is a time-consuming operation.

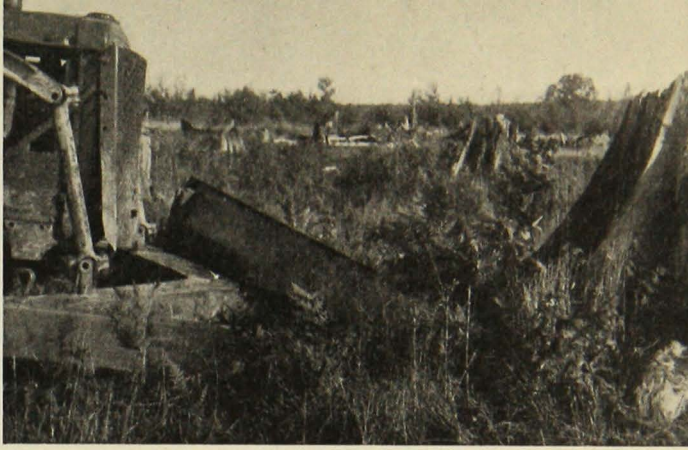
Many different kinds and sizes of stumps were on the farms included in our survey. Sixty-three per cent of the farmers reported white pine stumps; 30 per cent, poplar; and 26 per cent, Norway pine. Besides these there were balsam, spruce, ash, elm, maple, and some other varieties. On one third of the farms there were 60 or fewer stumps per acre and on one fifth there were over 100. Sixty per cent of the farmers reported that most of the stumps were medium size. The farmers were asked to state the diameter of the largest stump. These varied widely, but the average was 2.46 feet.

Most farmers hired the tractor with bulldozer primarily for stump removal. The amount per farm varied from 1 to 30 acres with an average of a little over 8. The number of acres cleared per hour varied greatly. This would be expected because the rate of clearing depends upon the number of stumps.

The time required per acre for removal depends on the age of the

Use Explosives on Big Stumps

It is practical to split large stumps like this (especially if they are green) with a charge of explosives before using the bulldozer.



stumps. The average time on those fields where the stumps were three years old or less was about two-thirds acre per hour. On farms where the stumps were over three years old, but less than 15, three-fourths acre per hour was cleared; and on farms with stumps 15 years old or over, the average was slightly more than one.

Removing Green Stumps Costly

Many farmers feel that it is uneconomical to remove green stumps. This seems logical because green stumps still have many fine, fibrous roots that hold large quantities of dirt when the stump is removed. It is difficult to remove this dirt from the stump. A large hole is left in the ground, and the stump is hard to burn. In fact, the cost of removing green stumps is considered prohibitive except under extraordinary conditions regardless of the method used.

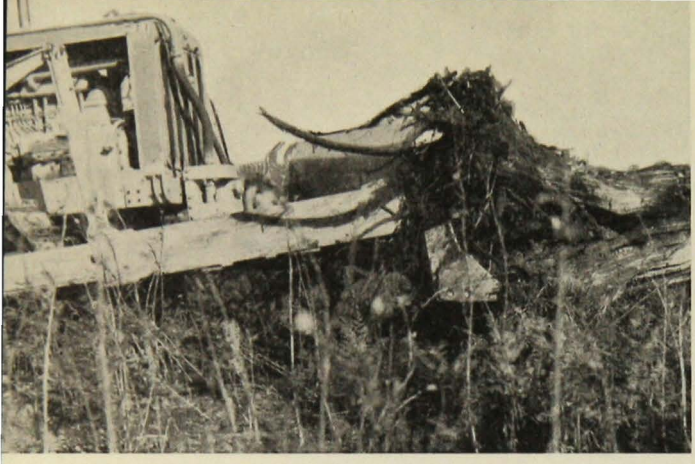
Many farmers cautioned against stump removal when the ground is wet because dirt sticks to the roots with most of the objections indicated above.

When the field is free from brush and down logs and the stumps are not green, an experienced operator can remove a surprisingly large number of stumps per hour. The experience and skill of the operator is the most important controllable factor determining the amount of work per day. He must be able to size up the situation rapidly and make a quick decision as to the best move and then lose no time in making proper manipulation of the tractor and bulldozer. It is easy to waste much time making unnecessary moves.

Stumps must be handled again for piling after they have been removed. To facilitate this secondary operation, large stumps should be broken into several pieces and dirt should be removed from the roots. In removing large stumps, one or two roots at a time may be broken off while the main part is still in the soil, and finally the main part of the stump may be pushed out.

Explosives Often Used

Another way to obtain comparatively small pieces is to crack large stumps with a small charge of explosives before pushing them out. This practice was followed on only one eighth of the farms, but 36 per cent of the farmers said that this method was advisable. Many farmers reported that, as a result of their experiences with large stumps, they would advise using explosives in connection with the bulldozer.



Removing Dead Stumps

Dead stumps are easily removed by the bulldozer. Very little dirt clings to the roots.

PILING

Disposing of stumps after they have been removed sometimes requires considerable time and labor. If stumps are large and sound and if the stump wood can be sold or used for fuel, it is advisable to make fuel of it. Studies made several years ago show that it costs about four dollars per cord to reduce sound, white pine stumps of moderate or large size to fuel size. This includes the cost of getting the stumps out of the ground, as well as assembling, piling, and further splitting.

Generally the stumps are piled up and burned, and on one fifth of the farms surveyed, the tractor and bulldozer piled as well as removed them. Some farmers were satisfied with the job and others were not. While it is possible under most conditions to make a fairly satisfactory, though small, pile with the bulldozer, small roots and pieces of stump wood must still be gathered by hand and piled. The bulldozer takes considerable time to pile the stumps in addition to pushing them out, and therefore the economy of this practice is questionable. Its practicability is to be questioned, especially because the farmer can do the piling with his team and labor which require no cash outlay. He will profit more by having the machine spend all of the time that he can afford to hire it at stump removal for which he must pay some cash anyway.

On most of the farms where the bulldozer worked, the stumps were piled by hand and with a team. A few owners used the farm tractor to gather and pile the stumps. About half of the farmers reporting stated that stumps removed by the bulldozer were easier to pile than those removed with dynamite, and the other half reported the opposite. Presumably the answer to this question depends on conditions and the facilities at hand for piling. Only one out of four complained about dirt sticking to the stumps removed by the bulldozer, whereas two thirds reported no disadvantage in this regard. Seven out of eight made no complaint about large holes left in the ground. This condition presumably is largely a result of the age of the stumps and the amount of moisture in the soil.

STONE REMOVAL

The bulldozer was used to remove stones on a few farms. Where boulders are comparatively large, it may be used to push stones out of the ground, to make a hole for burying them, or to push them to the edge of the field.

It is questionable if the latter practice is feasible because, as reported by some, it takes considerable time. Furthermore the stones will still be scattered above the ground. Because stones are difficult and costly to handle, they should be completely disposed of when clearing. This may be facilitated by breaking large boulders with explosives.

It is feasible to bury stones under some conditions such as in natural depressions where eroded soil is deposited on them. Trouble would naturally arise if stones were buried at the top of a knoll or on a slope where erosion, and consequent recession of the surface would expose them. Where boulders of moderate or large size are partly buried, the bulldozer can usually bring these to the surface.

OTHER MISCELLANEOUS WORK

Some farmers reported having certain laborious and expensive work done advantageously and cheaply with a track type tractor with bulldozer. In many cases the outfit was used for grading a short piece of road. It is well suited for this, and if much dirt need not be moved in making cuts and fills, the cost is low.

Open drainage ditches can also be quickly and effectively constructed especially if they are not deep so that cultivation can proceed over them.

The surface of many stump fields has small depressions and mounds known as "cradle knolls." The bulldozer can effectively and with little additional time level these off while stumping, and, at the same time, fill holes that have been created by removing large stumps.

RATES OF PERFORMANCE AND COST

The cost per acre of stumping with the track-type tractor and bulldozer depends on the charge per hour and the rate at which the work is done. At $5.00 per hour for equipment and operator (the charge for most outfits in 1939), stumps may be removed, under most conditions, at a low cost compared with other methods.

As has already been pointed out, the number of acres per hour varies with the skill of the operator and increases considerably as the age of the stumps

Fill in Holes While Clearing

Removing small mounds and filling stump holes can be done while clearing.

increases. In the survey it varies all the way from .3 on a number of farms to 2.7 on a 20-acre field of Norway pine stumps, the average being .821. At $5.00 per hour and this average rate of performance, the cost per acre would be $6.10. The necessary charge depends to a large extent on the life of the machine and the cost of repairs. Operating costs, including fuel and lubricants, are small in comparison with some of the others because most of these machines are equipped with diesel engines for which the fuel cost is comparatively low.

Because this equipment has not been used long for land clearing, it is difficult to estimate accurately its length of life. Obviously it is not the easiest kind of work for a tractor. When operators have had more experience using this type of equipment for stump removal, they will have a better idea of operating costs, the basis for the hourly charge. Because this type of tractor is used for road building and lumbering, the operator may, in some cases, arrange to keep it busy if and when land clearing work is not available. It is essential, from the standpoint of economy, that the equipment be used as many days in the year as possible. Enough units probably will be available to insure the work being done at a fair and reasonable rate.

CONCLUSION

In answering the questionnaire 89 per cent stated that using the bulldozer for clearing land was cheaper than other methods, and 72 per cent said they planned to use the outfit for clearing in the future.

Method Considered Practical

A majority of the reporters believe that the method is entirely practical and considerably cheaper than others previously used, and, moreover, has the advantage of doing the work in a comparatively short time. Because of the large cash cost for the use of the machine, it is generally agreed that the wise farmer will use it only for work which he cannot do with power and labor available on the farm. Furthermore, he will make the necessary preliminary preparations such as brushing and removing down logs so that he may obtain the maximum possible use of the outfit for stump removal. With this objective in mind, most farmers will hire the bulldozer to push the stumps out of the ground but will do the preliminary brushing and the subsequent piling of stumps with facilities on the farm.

Dissatisfaction, in most cases, is the result of attempting to clear under conditions where clearing is not feasible. This includes the removal of green stumps, working in wet ground, and the removal of mixed and medium size brush. It is also generally agreed that it is a matter of economy to crack large stumps with a small charge of dynamite before removing.

UNIVERSITY FARM, ST. PAUL, MINNESOTA

Cooperative Extension Work in Agriculture and Home Economics, University of Minnesota, Agricultural Extension Division and United States Department of Agriculture Cooperating, P. E. Miller, Director. Published in furtherance of Agricultural Extension Acts of May 8 and June 30, 1914. 10M-5-40